Notice No.5

Rules and Regulations for the Classification of Naval Ships, January 2021

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: November 2021

Amendments to	Effective date	IACS/IMO implementation (if applicable)
Volume 1, Part 1, Chapter 2, Section 3	1 January 2022	N/A
Volume 1, Part 1, Chapter 3, Section 2	1 January 2022	N/A
Volume 1, Part 1, Chapter 2, Section 1	1 January 2022	N/A
Volume 1, Part 3, Chapter 4, Section 9	1 January 2022	N/A
Volume 1, Part 3, Chapter 5, Sections 5, 6 & 10	1 January 2022	N/A

Lloyd's Register

Volume 1, Part 1,
Chapter 2
Classification Regulations

■ *Section 3*
Character of Classification and Class notations

3.10 Other notations

3.10.27 **BOATS, Boat Operations at Sea**. This optional notation will be assigned to naval vessels where the onboard arrangements for the launch, recovery and carriage of small boats, and the interfacing of the vessel with waterborne craft alongside or persons in the water, are demonstrated to be in accordance with the Functional Objectives and Performance Requirements of ANEP-77 NATO *Naval Ship Code (NSC)* and accepted by LR in accordance with requirements specified in *Vol 3, Pt 1, Ch 7 Boat and Waterborne Operations*.

Volume 1, Part 1,
Chapter 3
Periodical Survey Regulations

■ *Section 2*
Annual Surveys – Hull, machinery and optional requirements

2.3 Machinery

2.3.15 For Mobility, ~~Ship Type~~ ship type and emergency machinery control engineering systems, a general examination of the equipment and arrangements is to be carried out. Records of modifications are to be made available for review by the attending Surveyor. ~~The documentation required by *Vol 2, Pt 9, Ch 7 Control, Alerts and Safety Systems*, including configuration management, is to be reviewed following system modifications to confirm compliance with applicable Rules.~~ Satisfactory operation of the safety devices and control systems is to be verified. For ships having **UMS** or **CCS** notation, a general examination of the control engineering equipment required for these notations is also to be carried out.

2.3.16 For Mobility, ship type and emergency machinery control engineering systems implemented using programmable electronic systems and software, the impact of changes upon system functionality and the context of use, when carried out are to be assessed by the System Design Authority as defined in *Vol 2, Pt 1, Ch 3, 21.2 Definitions 21.2.3*. The party undertaking through-life management of the software is to document the configuration management activities undertaken in the registries required by *Vol 2, Pt 9, Ch 8, 5.4 Programmable electronic systems – Additional requirements for the production of software 5.4.2*. The registries are to be made available to the Surveyor for audit purposes.

2.3.17 Where remote access features or facilities for enabling temporary connections with external devices are included for the programmable electronic system(s), the Owner is to periodically review the provisions made within the associated hardware and software to ensure that new vulnerabilities and dependencies impacting safety have not occurred or have been adequately addressed to mitigate the risk related to their possible exploitation. The Surveyor is to confirm that this periodic review has been carried out by review of records, including review of test records, as applicable, and the registry of programmable electronic systems, logical (virtual) servers, desktops and network communication devices.

Existing paragraphs 2.3.16 to 2.3.19 have been renumbered 2.3.18 to 2.3.21

2.4 Other notations

2.4.9 **Boat Operations at Sea (BOATS).** The onboard arrangements for the launch, recovery and carriage of small boats, and for interfacing of the vessel with waterborne craft alongside or persons in the water are to be examined and are to include the following:

(a) Verification that no changes have been made to the provision of boats or permanently embarked watercraft designated for use onboard.

(b) Survey of the boat stations, embarkation stations, recovery stations and associated shipboard arrangements to confirm satisfactory working condition of the fittings, control arrangements, communications, lighting and equipment.

(c) Confirmation that the survey and test status of the launch and recovery appliances is up to date and verification that loose gear, lifting and securing equipment is appropriately certified and in effective condition.

(d) Verification of the protective and safety equipment for effectiveness and condition and a review of the log of inspections, maintenance and testing.
(e) Verification of the validity of certification for boats or watercraft permanently fitted onboard.

2.4.10 The first Annual Survey shall include confirmation by the Owner that operational trials for the launch and recovery of boats and watercraft in the defined operational conditions have now been completed and that any findings have been fed back into the Operator Guidance and to the Design Authority and building yards for future vessels.

2.4.11 The first Annual Survey shall include confirmation by the Owner that the required Operator Guidance has been found suitable for the defined operational use.

Volume 1, Part 1
Chapter 2
Classification Regulations

■ *Section 1*
Conditions for Classification

1.1 Framework of Classification

1.1.13 It is the responsibility of the ship designer to ensure that the ship is suitable for any intended lifting appliance operation.

1.1.14 When a vessel has been assigned a special features class notation associated with lifting appliances, then the applicable lifting appliances are to be built in accordance with the requirements of LR's *Code for Lifting Appliances in a Marine Environment*, *see Vol 1, Pt 1, Ch 2, 3.5 Ship type notations*.

Existing paragraphs 1.1.13 and 1.1.14 have been renumbered 1.1.15 and 1.1.16.

Volume 1, Part 3,
Chapter 4
Closing Arrangements and Outfit

■ *Section 9*
Bulwarks, guard rails, raised walkways and other means for the protection of crew and embarked personnel

9.8 Means of embarkation and disembarkation

9.8.1 A means of embarkation to and disembarkation from vessels for use in harbour or for alongside operations in open sea conditions is to be provided in accordance with an appropriate standard, e.g. IMO *MSC Circular.1331 – Guidelines for Construction, Installation, Maintenance and Inspection/Survey of Means of Embarkation and Disembarkation.*

~~9.8.1~~9.8.2 Accommodation ladders ~~and~~, embarkation ladders and gangways are to be in accordance with an appropriate recognised Standard, e.g. ISO 5488 *Accommodation ladders* ~~or –~~, ISO 5489 *Embarkation ladders* or ISO 7061 *Shipbuilding – aluminium shore gangways for seagoing vessels*.

■ *Section 5* Anchor Cable

5.5 Cable stopping and release arrangements

Table 5.5.1 Allowable stresses in windlass and chain stopper supporting structure

	Permissible stress N/mm^2
(a) For strength assessment by means of beam theory or grillage analysis (*see* Note 1):	
Normal stress ~~(*see* Note 1)~~	1,00 σ_0
Shear stress	~~0,58~~ 0,60 σ_0
~~Combined Stress (*see* Note 2)~~ Von Mises stress	1,00 σ_0
(b) For strength assessment by means of finite element analysis (*see* Note 2):	
Von Mises stress	1,00 σ_0
Symbols	
σ_0 = specified minimum yield stress, N/mm^2	
Note 1 Normal stress is defined as the sum of bending and axial stresses. The shear stress to be considered corresponds to the shear stress acting perpendicular to the normal stress. No stress concentration factors are to be taken into account.	
Note 2 ~~Combined stress refers to equivalent von Mises stress.~~ For strength assessment by means of finite element analysis, the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs, the web thickness is to be reduced to an appropriate mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled using shell or plane stress elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modelled using shell or plane stress elements, then dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.	

■ *Section 6* Mooring arrangements

6.1 Mooring lines

6.1.2 Ships of Rule length L_R 90 m or more are recommended to have mooring lines as specified in *Vol 1, Pt 3, Ch 5, 6.2 Mooring lines (Equipment Number ≤ 2000)* or *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000)* as appropriate. ~~In addition, it is recommended that the sum of the strengths of all the mooring lines supplied to such ships should be not less than the Rule breaking load of one anchor cable as required by *Table 5.4.1 Equipment - HHP Bower anchors and chain cables*, based on Grade U2 chain. On ships regularly using exposed berths, twice the above total strength of mooring ropes is desirable.~~

6.1.6 Ship Design Minimum Breaking Load (MBL_{SD}) is the minimum breaking load of new, dry mooring lines for which shipboard fittings and supporting hull structures are designed in order to meet mooring restraint requirements.

6.1.7 Line Design Break Force (*LDBF*) is the minimum force at which a new, dry, spliced, mooring line will break at. This is applicable to all synthetic cordage materials.

6.2 Mooring lines (Equipment Number ≤ 2000)

6.2.1 It is recommended that the ~~breaking strength~~ ship design minimum breaking load, length and number of mooring lines provided on board ships with equipment number of less than or equal to 2000 be not less than those specified in *Table 5.6.1 Equipment - Kedge anchors and wires, towlines and mooring lines*. The equipment number is to be calculated in accordance with *Vol 1, Pt 3, Ch 5, 2.1 Equipment Number calculation*. It is the ~~Owners~~ Owner and designer's responsibility to ensure the adequacy of the mooring equipment. ~~The equipment should be verified through carrying out ship specific mooring calculations. The mooring calculations are to be representative of the anticipated mooring configurations, as well as accounting for operational and environmental considerations. This section details minimum recommendations only, and where the calculations provide a lesser specification it is recommended that they be increased in accordance with this section.~~ The adequacy of minimum recommended mooring lines in this sub-section needs to be verified based on assessments carried out for the individual mooring arrangement, expected shore-side mooring facilities and design environmental conditions for the berth.

6.2.3 As an alternative to the minimum recommendations for mooring lines prescribed in this sub-section, the minimum recommendations for mooring lines may be determined by direct mooring analysis in accordance with the procedure given in Appendix A of IACS Recommendation 10 *Chain Anchoring, Mooring and Towing Equipment*.

6.3 Mooring lines (Equipment Number > 2000)

6.3.1 It is recommended that the ~~minimum breaking strength~~ ship design minimum breaking load, length and number of mooring lines for ships with an equipment number greater than 2000 are as defined in this sub-Section. The equipment number is to be calculated in accordance with *Vol 1, Pt 3, Ch 5, 2.1 Equipment Number calculation*. It is the ~~Owners~~ Owner and designer's responsibility to ensure the adequacy of the mooring equipment. ~~The equipment should be verified through carrying out ship specific mooring calculations. The mooring calculations are to be representative of the anticipated mooring configurations, as well as accounting for operational and environmental considerations. This section details minimum recommendations only, and where the calculations provide a lesser specification it is recommended that they be increased in accordance with this section.~~ The adequacy of minimum recommended mooring lines in this sub-section needs to be verified based on assessments carried out for the individual mooring arrangement, expected shore-side mooring facilities and design environmental conditions for the berth. A typical mooring arrangement is indicated in *Figure 5.6.1 Typical mooring arrangement* and the following is defined with respect to mooring lines.

(a) Breast line: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction.
(b) Spring line: A mooring line that is deployed almost parallel to the ship, restraining the ship in the fore or aft direction.
(c) Head/stern line: A mooring line that is oriented between longitudinal and transverse direction, restraining the ship in the off-berth and in the fore or aft direction. The amount of restraint in fore or aft and off-berth direction depends on the line angle relative to these directions.

6.3.2 The strength of mooring lines and the number of head, stern, and breast lines for ships with an Equipment Number > 2000 is based on the side-projected area A_1. Side projected area A_1 is to be calculated similar to the side-projected area A according to *Vol 1, Pt 3, Ch 5, 2.1 Equipment Number calculation* but considering the following conditions:

(a) For ships with substantial variation in ~~draft~~ draught such as fleet tankers, the ~~lightest~~ ballast ~~draft~~ draught is to be considered for the calculation of the side-projected area A_1. ~~For other ships the lightest draft of usual loading conditions is to be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two. Usual loading conditions mean loading conditions as given by the trim and stability booklet that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.~~ For ship types having small variation in the draught, the side projected area A_1 may be calculated using the summer load waterline.
(b) Wind shielding of the pier can be considered for the calculation of the side-projected area A_1 unless the ship is intended to be regularly moored to jetty type piers. The lower part of the side projected area above the waterline for the considered loading condition can be disregarded up to the pier height in the calculation of the side-projected area A_1. Where known, the actual height of the pier above the waterline may be used in the calculation. If the pier height cannot be pre-determined, an assumed height may be used. However, in both cases, the pier height shall not exceed 3 m.

6.3.4 The maximum wind speed V_w is representative of the mean wind speed over a 30 second period from any direction and at a height of 10 m above the ground. The current speed considered is a representative of the maximum current speed acting on bow or stern (±10°) at a depth of one-half of the mean ~~draft~~ draught. Furthermore, it is considered that the ships are moored to solid piers that provide shielding against cross currents.

6.3.6 The ~~minimum breaking strength~~ ship design minimum breaking load (MBL_{SD}), in kN, of the mooring lines is to be taken as:

~~*MBL*~~ MBL_{SD} = 0,1A1 + 350

where

A_1 = Side projected area as defined by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.2*

6.3.7 The ~~minimum breaking strength~~ ship design minimum breaking load may be limited to 1275 kN (130 tonnes). However in these cases, the moorings are to be considered as not sufficient for the environmental conditions given by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.3*. For these ships, the acceptable wind speed V_w^*, in m/s, to be calculated as follows:

$$\cancel{V_w^* = V_w \times \sqrt{\frac{MBL^*}{MBL}}}$$

$$V_w^* = V_w \times \sqrt{\frac{MBL_{SD}^*}{MBL_{SD}}}$$

where

V_w = wind speed as per *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.3*

~~*MBL**~~ MBL_{SD}^* = ~~the breaking strength of the mooring lines intended to be supplied~~ the intended ship design minimum breaking load

~~*MBL*~~ *MBL*SD = required ~~breaking strength~~ ship design minimum breaking load provided by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.6*

However, the intended ship design minimum breaking load MBL_{SD}^* ~~minimum breaking strength MBL*~~ is not to be taken less than that corresponding to an acceptable wind speed of 21 m/s:

$$\cancel{MBL^* \geq \left(\frac{21}{V_w^*}\right)^2 \times MBL}$$

$$MBL_{SD}^* \geq \left(\frac{21}{V_w}\right)^2 \times MBL_{SD}$$

6.3.8 If then the mooring lines are intended to be supplied for an acceptable wind speed V_w^*, higher than V_w as per *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.3*, the ~~minimum breaking strength~~ ship design minimum breaking load MBL_{SD}^* is to be taken as:

$$\cancel{MBL^* = \left(\frac{V_w^*}{V_w}\right)^2 \times MBL}$$

$$MBL_{SD}^* = \left(\frac{V_w^*}{V_w}\right)^2 \times MBL_{SD}$$

where

~~MBL~~ *MBL*SD = required ~~breaking strength~~ ship design minimum breaking load provided by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.6*

6.3.9 The total number of head, stern and breast lines is specified as:

$$n = 8{,}3 \times 10^{-4} \times A_1 + 6$$

where

A_1 = side projected area as defined by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.2*

The total number of head, stern and breast lines is to be rounded to the nearest whole number. The number may be increased or decreased in conjunction with an adjustment to the ~~strength of the lines~~ ship design minimum breaking load. The adjusted ~~strength, *MBL**,~~ ship design minimum breaking load MBL_{SD}^{**} is to be taken as:

$$\cancel{MBL^* = 1{,}2 \times MBL \times \frac{n}{n^*} \leq MBL\text{, for increased number of lines}}$$

$$\cancel{MBL^* = MBL \times \frac{n}{n^*}\text{ , for reduced number of lines}}$$

$$MBL_{SD}^{**} = 1{,}2 \times MBL_{SD} \times \frac{n}{n^{**}} \leq MBL_{SD}\text{, for increased number of lines}$$

$$MBL_{SD}^{**} = MBL_{SD} \times \frac{n}{n^{**}}, \quad \text{for reduced number of lines}$$

where

*MBL*SD = *MBL*SD or MBL_{SD}^*, if intended ship design minimum breaking load is different as provided by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.7* or *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.8*

n = number of lines for the considered ship type as calculated by the above formula without rounding

~~n^*~~ n^{**} = increased or decreased total number of head, stern and breast lines

Vice versa, the ~~strength~~ ship design minimum breaking load of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of lines.

6.3.10 The total number of spring lines, n_s is to be taken not less than:

Two lines where EN < 5000,
Four lines where EN ≥ 5000.

The ~~strength~~ ship design minimum breaking load of spring lines is to be the same as that of the head, stern and breast lines. If then the number of head, stern and breast lines is increased in conjunction with an adjustment to the ~~strength~~ ship design minimum breaking load of the lines, the number of spring lines is ~~also~~ to be ~~increased likewise~~ taken as follows, but rounded up to the nearest even number.

$$n_s^* = \frac{MBL_{SD}}{MBL_{SD}^{**}} \times n_s$$

where

MBL_{SD} = MBL_{SD} or MBL_{SD}^*, if the intended ship design minimum breaking load is different as provided by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.7* or *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.8*

MBL_{SD}^{**} = adjusted ship design minimum breaking load as provided by *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000) 6.3.9*

n_s = the number of spring lines as given above

n_s^* = the increased number of spring lines

6.3.11 As an alternative to the minimum recommendations for mooring lines prescribed in this sub-section, the minimum recommendations for mooring lines may be determined by direct mooring analysis in accordance with the procedure given in Appendix A of IACS Recommendation 10 'Chain Anchoring, Mooring and Towing Equipment'.

(Part only shown)

Table 5.6.1 Equipment - Kedge anchors and wires, towlines and mooring lines

Equipment number		Equipment Letter	Mass of stockless kedge anchor, in kg	Kedge anchor wire or chain (*see* Notes 1 and 2)		Mooring lines (*see* Notes 2 and 5)		
Exceeding	Not exceeding			Minimum length, in metres	Minimum breaking strength, in kN	Number	Minimum length of each line, in metres	~~Minimum breaking strength~~ ship design minimum breaking load (*MBL*$_{SD}$), in kN

6.6 Bollards, fairleads and bull rings

6.6.1 Means are to be provided to enable mooring lines to be adequately secured on board ship.

6.6.2 It is recommended that the total number of suitably placed bollards on either side of the ship and/or the total brake holding power of mooring winches should be capable of holding not less than 1,5 times the sum of the ~~maximum breaking strengths~~ ship design minimum breaking load (*MBL*$_{SD}$) of the mooring lines ~~required or~~ recommended.

~~6.6.3 Bollards, fairleads and bull rings are to be located on longitudinals, beams and/or girders, which are part of the deck construction so as to facilitate efficient distribution of the mooring load. Other equivalent arrangements (Panama chocks etc.) will be considered providing the strength is confirmed as adequate for the intended use.~~

~~6.6.4 It is recommended that shipboard fittings are selected in accordance with an Industry standard (e.g. ISO13795 Shipbuilding Welded Steel Bollards) accepted by the Society. When the shipboard fitting is not selected from an accepted Industry standard, the design load used to assess its strength and its attachment to the ship is to be in accordance with Vol 1, Pt 3, Ch 5, 6.9 Support structure of deck fittings 6.9.1 and the design is to be submitted for approval.~~

~~6.6.5 The SWL of each shipboard fitting is not to exceed 80 per cent of the design load as per Vol 1, Pt 3, Ch 5, 6.9 Support structure of deck fittings 6.9.1. It is to be marked (by weld bead or equivalent) on the deck fittings used for mooring. The SWL with its intended use is to be noted in the mooring arrangement plan or other information available on board for the guidance of the Master. These requirements for SWL apply for a single post basis (no more than one turn of one cable). The arrangement plan is to explicitly prohibit the use of mooring lines outside of their intended function.~~

6.7 Mooring arrangement and winches

6.7.4 The mooring winch is to be fitted with brakes, the holding capacity of which is sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80 per cent of the ~~minimum breaking strength~~ ship design minimum breaking load of the rope as fitted on the first layer. The winch is to be fitted with brakes that will allow for the reliable setting of the brake rendering load.

6.7.5 For powered winches the maximum hauling tension which can be applied to the mooring line (the reeled first layer) is to be not less than 2/9, nor to be more than, 1/3, of the rope's ~~minimum breaking strength~~ ship design minimum breaking load. For automatic winches these figures apply when the winch is set to the maximum power with automatic control.

6.8 Mooring line construction

6.8.2 Notwithstanding the strength recommendations, no fibre rope shall be less than 20 mm in diameter. For polyamide ropes the ~~minimum breaking strength~~ line design break force is to be increased by 20 per cent and for other synthetic ropes by 10 per cent to account for strength loss due to, among other causes, aging and wear.

6.9 ~~Support~~ Deck fittings and support structure ~~of deck fittings~~

6.9.5 Shipboard fittings are to be selected from an acceptable National or International standard and to be based on the ~~minimum breaking strength of the mooring line~~ ship design minimum breaking load as given in *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.1* or *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.2* as appropriate (*see* Note 2 of *Table 5.6.2 Minimum design load for deck fittings and supporting structure - Mooring*).

6.9.6 Mooring bitts (double bollards) are to be chosen for the mooring line attached in figure-of-eight fashion if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye-splice attachment. With the line attached to a mooring bitt in the usual way (figure-of-eight fashion), either of the two posts of the mooring bitt can be subjected to a force twice as large as that acting on the mooring line. Disregarding this effect, depending on the applied industry standard and fitting size, overload may occur.

Table 5.6.2 Minimum design load for deck fittings and supporting structure – Mooring

Use/Item	Minimum design load (*see* Notes 1 to 2)
Mooring (Fittings and its supporting hull structure)	1,15 times the ~~breaking strength of the mooring lines~~ ship design minimum breaking load given in *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.1* or *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.2* as appropriate
Winches (Supporting hull structure only)	1,25 times the intended maximum brake holding load, where the maximum brake holding load is to be assumed not less than 80% of the ~~minimum breaking strength of the mooring line~~ ship design minimum breaking load given in *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.1* or *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.2* as appropriate
Capstans (Supporting hull structure only)	1,25 times the maximum hauling in force, where hauling in force is defined as the maximum pull of the capstan or 1,25 times the intended maximum brake holding load if that be greater
Note 1. When a safe working load SWL greater than that determined according to the Rules is requested, the design load is to be increased in accordance with the appropriate SWL/design load relationship given in *Vol 1, Pt 3, Ch 5, 6.9 Support structure of deck fittings 6.9.12* **Note** 2. The increase of the ~~minimum breaking strength~~ line design break force for synthetic ropes need not to be taken into account for the loads applied to shipboard fittings and supporting hull structure.	

6.9.10 In the case of strength assessment using beam theory or grillage analysis, the stress within the supporting structure of fittings, with net scantlings, is not to exceed that given in *Table 5.6.3 Allowable stress within the supporting structure of shipboard fittings*.

6.9.11 ~~For strength calculations by means of finite element analysis, the geometry is to be idealised as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges are generally to be modelled by beam or truss elements. At least 3 elements are to be used across the depth of the girder. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners are generally to be modelled by using shell, plane stress, or beam elements. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element. The equivalent stress within the supporting structure of fittings is not to exceed the specified minimum yield strength of the material.~~

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed three. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third

of the web height. In way of small openings in girder webs the web thickness is to be reduced to an appropriate mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled using shell or plane stress elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modelled using shell or plane stress elements, then dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element. The Von Mises stress within the supporting structure of fittings, calculated with net scantlings, is not to exceed the specified minimum yield strength of the material.

6.9.12 The Safe Working Load (SWL) is the safe load limit of shipboard fittings used for mooring purposes. Unless a greater SWL is requested, the SWL assigned shall be the ~~minimum breaking strength of the mooring line~~ ship design minimum breaking load given in *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.1* or *Vol 1, Pt 3, Ch 5, 6.1 Mooring lines 6.1.2*, (*see* Note 2 of *Table 5.6.2 Minimum design load for deck fittings and supporting structure - Mooring*).

6.10 Mooring arrangements plan

6.10.2 Information provided on the plan is to include in respect of each shipboard fitting:

(a) location on the ship;
(b) fitting type;
(c) SWL;
(d) purpose, i.e. mooring; and
(e) manner of applying towing or mooring line load, including limiting fleet angles~~.~~, i.e. angle of change in direction of a line at the fittings.

Furthermore, information provided on the plan is to include:

(f) the arrangement of mooring lines showing number of lines (*N*);
(g) the ~~minimum breaking strength of each mooring line (*MBL*)~~ ship design minimum breaking load (MBL_{SD} , MBL_{SD}* or MBL_{SD}** as appropriate); and
(h) the acceptable environmental conditions, the minimum environmental conditions are as given in *Vol 1, Pt 3, Ch 5, 6.3 Mooring lines (Equipment Number > 2000)* for the recommended ~~minimum~~ ship design minimum breaking load ~~breaking strength of mooring lines~~ for ships with EN > 2000:
  - 30 second mean wind speed from any direction (V_w or V_w^*)
  - Maximum current speed acting on bow or stern (±10°).

Note Item (c) with respect to items (d) and (e), is subject to approval. ~~Fleet angle is defined as the maximum angle the line deviates from a direction perpendicular to the drum axis of a mooring/towing winch.~~

■ *Section 10*
Anchoring equipment in deep and unsheltered water

10.3 Anchor windlass and chain stopper

10.3.1 ~~The~~ Notwithstanding the requirements according to *Vol 1, Pt 3, Ch 5, 8.4 Windlass design 8.4.1*, the windlass unit prime mover is to be able to supply for at least 30 minutes a continuous duty pull Z_{cont}, in N, given by:

$$Z_{cont} = 35\, d^2 + 13{,}4\, m_A$$

where

d = chain diameter, in mm, as per *Table 5.10.1 Anchoring equipment for ships in unsheltered water with depth up to 120 m*

m_A = HHP anchor mass, in kg, as per *Table 5.10.1 Anchoring equipment for ships in unsheltered water with depth up to 120 m*

10.3.4 ~~As far as practicable, for testing purposes the speed of the chain cable during hoisting of the anchor and cable is to be measured over 37,5 m of chain cable and initially with at least 120 m of chain and the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82,5 m is to be at least 4,5 m/min.~~
In addition to the requirements *of Vol 1, Pt 3, Ch 5, 8.11 On-board testing 8.11.2*, as far as practicable, for testing purposes the speed of the chain cable during hoisting of the anchor and cable should be measured over 37,5 m of chain cable and initially with at least 120 m of chain with the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82,5 m should be at least 4,5 /min.

Table 5.10.1 Anchoring equipment for ships in unsheltered water with depth up to 120 m

Equipment Number EN_1		High holding power stockless bower anchors		Stud link chain cable for bower anchors		
~~Exceeding~~ Equal to or greater than	~~Not exceeding~~ Less than	Number	Mass per anchor (m_A) (kg)	Length (m)	Min. diameter (d): Special quality (Grade U2) (mm)	Min. diameter (d): Extra special quality (Grade U3) (mm)
	1790	2	14150	1017,5	105	84
1790	1930	2	14400	990	105	84
1930	2080	2	14800	990	105	84
2080	2230	2	15200	990	105	84
2230	2380	2	15600	990	105	84
2380	2530	2	16000	990	105	84
2530	2700	2	16300 ~~15900~~	990	105	84
2700	2870	2	16700 ~~15800~~	990	105	84
2870	3040	2	17000 ~~15700~~	990	105	84
3040	3210	2	17600 ~~15600~~	990	105	84
3210	3400	2	18000 ~~15500~~	990	105	84
3400	3600	2	18300 ~~15400~~	990	106 ~~105~~	84
3600	3800	2	19000 ~~16600~~	990	107	85 ~~87~~
3800	4000	2	19700 ~~17800~~	962,5	108 ~~107~~	87
4000	4200	2	20300 ~~18900~~	962,5	111	90
4200	4400	2	21100 ~~20100~~	962,5	114	92
4400	4600	2	22000	962,5	117	95
4600	4800	2	22900 ~~22400~~	962,5	119 ~~120~~	97
4800	5000	2	23500	962,5	122 ~~124~~	99
5000	5200	2	24000	935	125 ~~127~~	102
5200	5500	2	24500	907,5	130 ~~132~~	105 ~~107~~
5500	5800	2	25000	907,5	133 ~~132~~	107
5800	6100	2	25500	880	137	111
6100	6500	2	25700 ~~25500~~	880	140 ~~142~~	113 ~~114~~
6500	6900	2	26000	852,5	143 ~~142~~	115 ~~117~~
6900	7400	2	26500	852,5	147	118 ~~117~~
7400	7900	2	27000	825	152	121 ~~122~~
7900	8400	2	27500 ~~27000~~	825	154 ~~-~~	123 ~~127~~
8400	8900	2	28000 ~~27000~~	797,5	158 ~~-~~	127
8900	9400	2	28900 ~~27000~~	770	162 ~~-~~	132
9400	10000	2	29400 ~~27000~~	770	-	135 ~~137~~

10000	10700	2	29900 ~~27000~~	770	-	139 ~~142~~
10700	11500	2	30600 ~~27000~~	770	-	143 ~~142~~
11500	12400	2	31500 ~~29500~~	770	-	147
12400	13400	2	33200 ~~31500~~	770	-	152
13400	14600	2	35000 ~~34500~~	770	-	157
14600		2	38000	770	-	162

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